The background of the slide is a composite image of space. In the lower-left foreground, a curved horizon of Earth is visible, showing blue oceans and white clouds. In the upper-right, the Moon is shown in a large, detailed view, with its craters and maria clearly visible. Further in the distance, another smaller celestial body, possibly Mars, is visible. The background is filled with numerous stars of varying brightness and colors, creating a deep space atmosphere.

Cell Science-02 Payload Overview

**Wednesday, July 23, 2014
POIWG Meeting
NASA Marshall Space Flight Center**



Background



- The Cell Culture Module (CCM) was selected for modification for ISS based on a joint ARC/JSC assessment that it could meet the cell science priorities, requirements, and capability gaps conducting long duration (30-60 day) cell and microbiology research on ISS
- Two projects resulted from this funding:
 1. Cell Biology Technology Demonstration (CBTD) – SpX-2 mission duration
 2. The next generation CCM for ISS – Bioculture System (target SpX-5/Inc 41/42 Validation Flight)
- Cell Science-02 is the first PI flight of the Bioculture System hardware





Payload Selection History



- Experiment presented to the DoD Space Experiment Review Board (SERB)
 - Approved and selected for funding: Nov. 2013 (approval/selection renewal)
- Assigned to NASA JSC U.S. Air Force Space Test Project as experiment and PI representative: 2012
 - MEI Technologies (Contractor, NASA JSC)
- CASIS becomes payload ISS sponsor: 2013
- NASA ARC Bioculture System Project approved as payload implementation partner by NASA JSC Code OZ: Spring, 2014
 - Assigned to the NASA ARC Cell Science-2 (CS-02) mission
 - CS-02 Kick-Off: April, 2014





Project Team



CASIS: Bill McLamb, Ph.D.
Operations Project Manager

NASA JSC STP: K. Paige McClung
Tissue Regeneration Payload Manager
STP PI and Experiment Representative
MEI Technologies

NASA ARC Bioculture System Project: Kick-Off Team
Edward Austin – Project Manager
Kevin Sato, Ph.D. – LM Project Scientist, PI Phase Lead
Eduardo Almeida, Ph.D. – NASA Project Scientist
Garret Fitzpatrick – NASA Project Engineer
Lance Ellingson – LM Project and System Engineer
Sarah Mitchell – LM Project Operations
Diana Ly – LM Operations Engineer
Susan Suffel – NASA Safety Lead





Payload Flight Summary



- CASIS manifest allocation on SpX-7
 - NLO/CASIS sponsor designation
- Experiment is delivered to and returns from ISS on SpX-7
- Experiment executed during Increment 43/44



Science Overview



Pan-omics investigation to understand the impact of microgravity on osteoblast lineage cells treated with bone morphogenic protein-2 (BMP-2) or thrombopoietin (TPO)

PI: Rasha Hammamieh, Ph.D.

US Army Center for Environmental Health Research, MD

Co-PI: Melissa Kacena, Ph.D.

Indiana University, School of Medicine

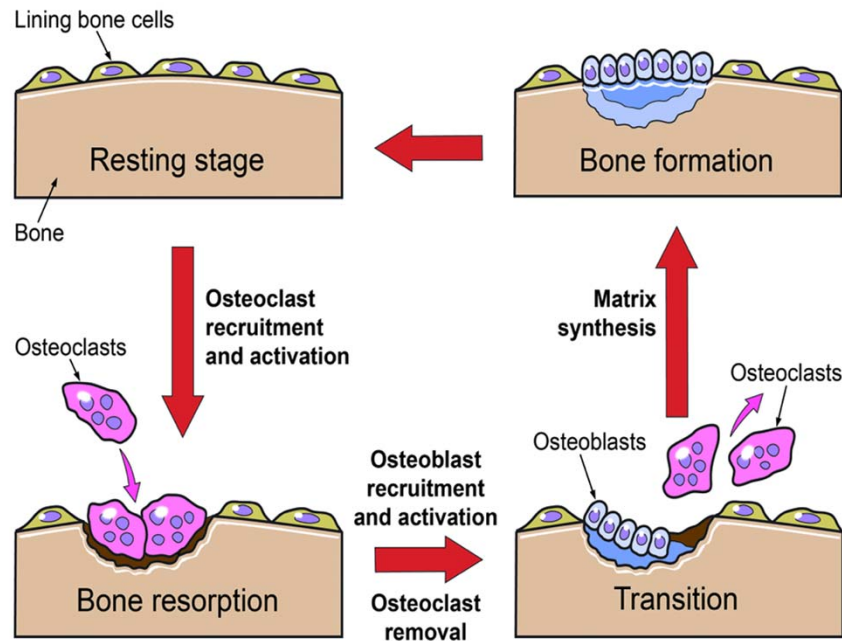




Science Overview



Bone Remodeling



- Current antiresorptive therapies for osteoporosis exist but have significant side effects
- Test two promising protein factors on osteoblast lineage cells in μg
 - Evaluate fundamental cellular, biochemical, and molecular responses to these agents in the μg environment

Osteoporosis and in microgravity there is an “uncoupling” of osteoclast bone resorption process from osteoblast bone formation processes resulting in a net loss of bone



Science Hypothesis and Specific Aims



Hypothesis:

- 1) Protein factors will differentially impact osteoblast differentiation in terrestrial versus microgravity conditions
- 2) microgravity-specific biomarkers/networks associated with bone differentiation could have significant relevance in the astronaut therapeutic program.

Specific Aim 1 *Determine whether osteoblast lineage cells treated with Protein factors have altered multi-omics signatures. The deliverables include biomarkers, and the associated networks indicating the efficacy of these agents in restoring bone health.*

Specific Aim 2 *Determine how gravity manipulates the multi-omics signatures of osteoblast lineage cells treated with Protein factors. The deliverables may elucidate the gravitational impact on bone health and measure the efficacy of these two osteoinductive agents for the betterment of astronauts' health.*



Ground Control



- Synchronous ground control
- Ground control run at KSC SSPF
- Requires cells that are from the same vial thaw and number of passages
 - ∞ The cells are temporarily culture before load into the bioreactors, which is why a synchronous ground control is required

Molecular expressions of the cells vary from passage to passage; loading to bioreactors and numerous other environmental factors can affect their regulations, as well. *We'll not be able to control all of them unless both experiments are conducted synchronously.*

Alternate arrangement, therefore could potentially risk of losing >80% of scientific validity.



The Bioculture System



- EXPRESS Rack Locker housed payload (Dragon powered locker for ascent and return)
- 10 independent, removable cassettes
- Housed in a docking station structure
- Front loaded replaceable gas supply
- Standard rack power and communication
- Rear breather for improved air flow/heat rejection
- 17.04" x 9.67" x 20.32"
- CG at (10.17, -8.5, 5.245)
- Weight 61 lbs without locker (+11 lbs)





Mission Support



- *Payload Integration Manager (PIM):*
Amy Haas, amy.s.haas@boeing.com
- *Research Integration Manager (RIM):*
Brienne Shkedi, brienne.shkedi@nasa.gov
- *Payload Operations Lead, MSFC:*
Tony Cox, tony.w.cox@nasa.gov



Operations Flight Overview



- Launch (June 2015 TBD) and Return on SpaceX-7 in Inc 43/44
- Powered internal payload operational for full Mission Duration
- Payload Integration Agreement (PIA) Letter (currently in work) will contain the following unique agreements:
 - Late load of L-24 hours or later (request for L-18 hours)
 - Early retrieval of continuously powered Bioculture System and samples at Recovery dock
 - Live cells returning in the Bioculture System
 - Soft stowed specimens returned at JSC
 - 150 W powered on Dragon (2 locker spaces)
 - Power interruption of no more than 15 minutes at any time
- Pre-flight specimen and hardware processing in the KSC SSPF
- Post-flight science at PI laboratories
- Ground Control will be conducted in parallel (TBD) in the KSC SSPF lab
- Use of ISS facilities:
 - EXPRESS
 - Microgravity Science Glovebox (MSG)
 - MELFI (and Cold Stowage on Dragon – GLACIER or DCB)
 - Wetlab1 Items (gloves, wipes, absorbent pads)



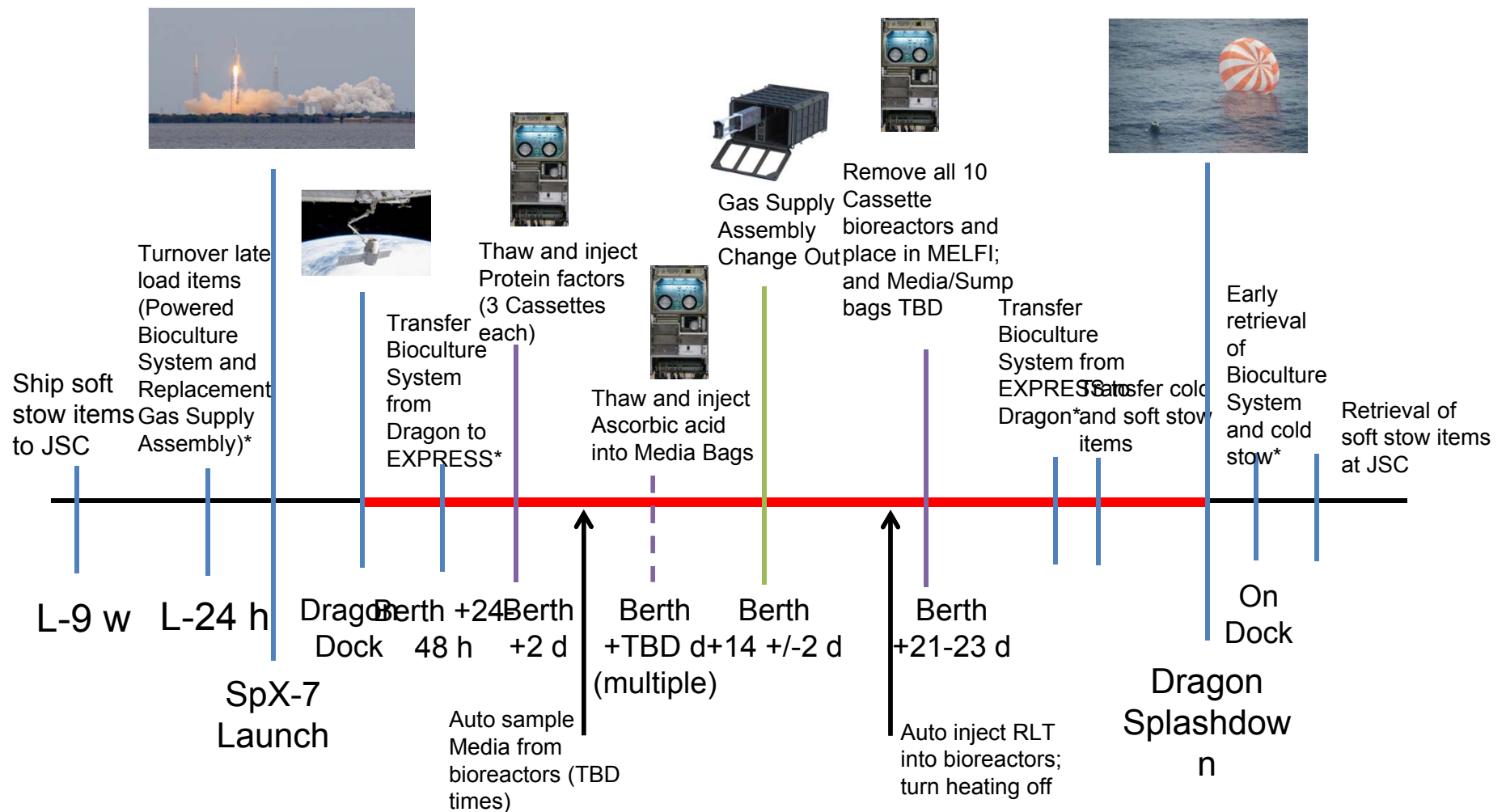
Documentation Status and Planning



- Manifest documentation submitted for:
 - Payload Candidate List (PCL)
 - Feasibility Assessment
 - Payload Tactical Plan (PTP)
 - 2-pager
 - Cold Stowage Form
 - Investigator Summary Form (ISF)
- Manifest Change Evaluation Form (CEF) will be submitted after further PI testing
- PIA in draft review
- PIM schedule drafted
- Planned next work:
 - Ops Plan will be finalized for Mission Intermediate Review
 - Training Strategy Team (TST) meeting for Crew Training planning will be held in August 2014 TBD
 - Initial Wetlab1, MSG, and Blankbook requests to be submitted by end of July 2014



Operations Timeline



* Best effort for no more than 15 minutes powered off during transfers



Experiment Unique Equipment (EUE)



Ascent



Soft Stow:

- Thawing Tool (TBD)
- Bioreactor Stowage Bags
- Media/Sump Stowage Bags
- Waste Bag
- Wipes Kit (for use in MSG)
- Tube Cutter
- O-rings (for use in MSG)
- Replacement Gas Supply Assembly

Cold Stow:

- Frozen syringes of TPO, BMP-2, and Ascorbic Acid

Return



Soft Stow:

- Thawing Tool (TBD)
- Waste Bag
- Wipes Kit (for use in MSG)
- Tube Cutter
- O-rings (for use in MSG)
- Original Gas Supply Assembly

Cold Stow:

- Bioreactors in Stowage Bags
- Media/Sump Bags in Stowage Bags (TBD)

* Items in blue were not included on Validation Flight